

Appl. No. 09/681,304
Amdt. Dated 5 November 2003
Reply to Office action of 6 August 2003

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Appl. No. : 09/681,304
Applicant : R.J. Saia et al.
Filed : 15 March 2001
Title : Microelectromechanical System Device Packaging Method
TC/A.U. : 2814
Examiner : Nguyen, Dilinh P
Docket No. : RD28435-2

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

RESPONSE UNDER 37 CFR 1.111

In response to the Office action of 6 August 2003, please consider the following remarks.

REMARKS/ARGUMENTS

In the Office action dated 6 August 2003, claims 1-4, 6 and 16 were rejected under 35 USC 103(a) on Gorowitz et al., US Patent No. 5,757,072 (hereinafter Gorowitz) in view of Noddin, US Patent No. 5,731,047 and further in view of Li et al., US Patent No. 6,499,214 (newly cited and hereinafter Li); claims 7-8 and 19 were rejected under 35 USC 103(a) on Gorowitz and Noddin and further in view of Scherer, US Patent No. 5,757,072 (newly cited); and claim 19 was objected to. Claims 5, 9-15, 17-18, and 20-25 were canceled in earlier amendments.

Claims 1-4, 6-8, 16, and 19 remain in this application.

Claims 1-4, 6, and 16

Independent Claim 1 (from which claims 2-4 and 6 depend) and independent claim 16 define allowable subject matter over Gorowitz, Noddin, and Li.

Independent claim 1 recites: "using a partially-cured adhesive to attach a release sheet to a MEMS package flexible layer" and "providing a cavity having a smooth surface perimeter and extending through the release sheet and at least partially through the MEMS package flexible layer." Independent claim 16 recites: "partially curing the adhesive," "using the adhesive to attach a release sheet to the MEMS package flexible layer," and "providing a cavity having a smooth surface perimeter and extending through the release sheet, the adhesive,

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and at least partially through the MEMS package flexible layer." A smooth surface perimeter is useful for the reasons stated in paragraph 16, lines 3-11, of Applicants' Specification:

"Smooth-surfaced perimeter" is meant to encompass any perimeter without sharp edges (such as 90 degree corners in square or rectangular perimeters). Examples of smooth-surfaced perimeters include ovals, circles, rounded rectangles as shown in FIG. 3, or other straight line perimeters having rounded corners or corners of greater than 120 degrees, for example. Smooth-surfaced perimeters are useful for evenly distributing any excess adhesive that is close to the surface of MEMS structure 22. Harsh-surfaced perimeters such as 90 degree corners create the potential for localized stress and excess flow of adhesive (and thus the potential for interference with MEMS structure 22).

As the Office Action indicates, Gorowitz and Noddin fail to disclose a cavity having a smooth surface perimeter.

Gorowitz appears to relate to deposition of a protective cap 16 over an air bridge structure of an integrated circuit chip.

Noddin appears to relate to a method of forming a blind via in a laminated substrate using a plurality of laser pulses (abstract) and was cited in the office action in regards to column 31, lines 10-15:

The partially-cured adhesive composite thus produced comprised of 57 weight percent TiO_2 , 13 weight percent PTFE and 30 weight percent epoxy adhesive. Several plies of the adhesive sheet were laid up between copper foil and pressed at 600 psi in a vacuum-assisted hydraulic press at temperature of 225 °C. for 90 min.

The Office Action includes a new citation of Li. Applicants respectfully submit, however, that the description of Li does not overcome the missing material in the descriptions of Gorowitz and Noddin with respect to Applicants' claims.

Li appears to relate to a method for making multi-layer circuit boards with metallized apertures and air-bridges (abstract). The Office Action cites FIGs. 5c-5f and column 12, lines 53 et sequ. and states that Li describes:

[U]sing an adhesive 204 to attach a release sheet 210 to a member layer 202, providing a cavity having a smooth surface perimeter and extending through the release sheet and at least partially through the member layer 202; removing the release sheet 210.

Applicants respectfully traverse the Office Action's characterization of Li. One reason for the traversal is that, in Li, the adhesive is not used to attach a release sheet. Element 210 appears to be a photoresist layer (Li, column 12, lines 14-15) which is applied over an adhesive layer for the purposes of patterning the adhesive and the core member 202. A more significant reason for the traversal is that Applicants can still find no reference to a smooth surface perimeter. Although patterning is described (Li, column 12, lines 20-26), no particular details about the shape appear to be provided. Further, Applicants can find no reference to a smooth perimeter in the cited lines 53 et sequ.

Thus, Applicants submit that, because the proposed modification of Gorowitz and Noddin which the Office Action sets forth and bases on Li, is not taught, suggested, or disclosed by Li, a prima facie case for a 35 USC 103(a) rejection has not been met.

Accordingly, Applicants respectfully submit that claim 1, claims 2-4 and 6 which depend therefrom, and

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claim 16 define allowable subject matter over the applied art. Withdrawal of the rejections is respectfully requested, and allowance of the claims is respectfully solicited.

Claims 7-8

Claims 7 (from which claim 8 depends) recites "providing a protective coating in the cavity" and "then removing the release sheet."

As described in paragraph 17, the process of claim 7 results in protective coating remaining only in the cavity. Thus, the order of events permits the protective coating to be easily blanket-sputtered and easily removed so as to remain in the desired location.

As stated above, Gorowitz appears to relate to deposition of a protective cap 16 over an air bridge structure of an integrated circuit chip, and Noddin appears to relate to a method of forming a blind via in a laminated substrate using a plurality of laser pulses (abstract) and was cited in the office action in regards to column 31, lines 10-15. No combination of Gorowitz and Noddin describes providing the protective coating in the cavity, removing the release sheet and attaching the MEMS device ... with a MEMS structure positioned in the cavity.

Newly cited Scherer does not overcome these deficiencies. Scherer appears to relate to a microcircuit sealing method (title).

In a first embodiment of Scherer (FIG. 1, column 5, lines 1-12) the seal is provided by a three layer process which encapsulates the circuit and thus would prevent movement and not be suitable for MEMS applications:

According to one embodiment of the invention, shown in FIG. 1, a three layer hermetic seal for a microcircuit is provided. The first layer 30 consists of a coating encapsulating the microcircuit in order to isolate, protect from contamination and insulate the microcircuit; the second layer or cover 32 further protects and insulates the microcircuit; and the third layer 34 is a non-organic coating, such as a molten metal or a glass, which is sprayed over the second layer covering the cavity 17 and the sealing surface 23 so that the non-organic coating fuses to the sealing surface in order to hermetically seal the microcircuit package.

In a second embodiment of Scherer (FIG. 2, column 7, lines 18-40 – and also shown in FIG. 3) encapsulation is avoided by application of a spacer block followed by the seal layer:

In certain applications it may be desirable not to encapsulate the microcircuit in a first layer coating 30. According to another embodiment of the invention, as shown in FIG. 2, the microcircuit may be isolated from the non-organic coating by providing an atmosphere space 36 over the microcircuit. The space may be defined by a spacer 38 made of a material, such as ceramic, which can withstand the temperatures of applying and curing the non-organic layer 34 and thus serves as a protective layer to the microcircuit. The spacer 38 and the cavity may be made in any way which is conventional in the art. Spacer 38 is attached to the package by means of any suitable bonding agent 40. In a preferred form, bonding agent 40 would be an epoxy compound of the same type used for coating 30 in the previously disclosed embodiment. Similar to the method used to seal the embodiment of FIG. 1, the microcircuit package would then be placed on a conveyor which acts as a heat sink and sprayed with a non-organic coating such as a molten metal or a molten glass to form the hermetic seal for the microcircuit. If a metal spray is used, a metallized sealing surface would be used also, as disclosed above.

In either embodiment of Scherer, the coating 34 which is providing the primary protection is on the outermost surface of the package. For this reason, Applicants traverse the Office Action statement that Scherer

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describes a coating "inside" a cavity with the citation of column 10 wherein claims 19 and 20 relate to spraying a coating (on the outside).

Additionally, None of the references or any combination relates to the order of steps identified in claim 7.

For this reason, Applicants respectfully submit that, even if one were to assume that the teachings or suggestions of Gorowitz, Noddin, and Scherer were to be combined, no combination of the references teaches or suggests the claim recitations.

The specific motivation for applying the coating prior to removing the release sheet is not shown in the Office Action. As described in paragraphs 17-18 of the Specification, this ordering is useful for permitting blank application of the protective coating which will then only remain in the cavities after removal of the release layer. As stated in Applicants' last amendment, this feature would be difficult to realize with the Gorowitz embodiment. Page 3 of the Office Action characterizes element 32 as a Kapton polyimide film in an attempt to fit it into Applicants' characterization of a "release sheet." Gorowitz however, calls element 32 a "hard mask layer" (column 9, line 3) with examples being metals which typically require etching for removal (see column 9, lines 5-15).

Accordingly, Applicants respectfully submit that claim 7 and claim 8 which depends therefrom define allowable subject matter over the applied art. Withdrawal of the rejections is respectfully requested, and allowance of the claims is respectfully solicited.

Claim 19

Claim 19 was objected to as being dependent upon a rejected base claim. The Examiner indicated that claim 19 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claim 19 depends from claim 16 which applicant believes is patentable for the reasons discussed above. Applicant respectfully submits that claim 19 is patentable in its present condition.

Summary

In view of the foregoing, applicants respectfully request that a timely Notice of Allowance be issued in this case..

Should the Examiner believe that anything further is needed to place the application in even better condition for allowance, the Examiner is requested to contact applicants' undersigned representative at the telephone number below.

Respectfully submitted,

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